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# An Individual-based Index of Multidimensional Poverty for Low- and Middle-Income Countries

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## ABSTRACT




This paper proposes a new index of multidimensional poverty, called the Global Correlation Sensitive Poverty Index (G-CSPI), which has three interesting features. First, it encompasses three dimensions: decent work, education and access to drinking water and sanitation, which largely overlap with the list of ideal dimensions obtained by expanding the Constitutional Approach, although it does not include direct health measures. Second, it uses a distribution-sensitive measure that can also be decomposed into the three poverty components: incidence, intensity and inequality. Finally, the G-CSPI is an individual-based, rather than household-based index, although restricted to individuals 15–65 years of age. It is thus able to detect intra-household differences in poverty among members within that age-range. To have a full picture of multidimensional poverty at the country level, it should then be complemented by specific poverty measures for children and the elderly. Being centred on individuals and sensitive to inequality, the G-CSPI is coherent with the overarching principle of the 2030 Agenda “leaving no one behind”. Using recent estimates of the G-CSPI for 104 countries, the empirical analysis reveals that the index is highly robust to different specifications, and that, as expected, fragile countries experience the largest levels of poverty.

## KEYWORDS

Poverty; capability approach; inequality; well-being; gender; measurement

## Introduction

The international community has historically put great emphasis on the eradication of poverty. Compared to the Millennium Development Goals (MDG)

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agenda, however, the 2030 Agenda has substantially enlarged the view of poverty. While Target 1.1 of the first Sustainable Development Goal (SDG) concentrates on the eradication of income poverty, Target 1.2 goes beyond the income dimension and calls for halving “the proportion of men, women and children of all ages living in poverty *in all its dimensions*”. This important step has been the consequence of a vivid debate in academia over the last 20–30 years, which pushed for a recognition of the multidimensionality of poverty. This view has then characterised the work of an increasing number of international organisations (UNDP 2010; UNICEF & End Child Poverty Global Coalition 2017).

In order to make decisions about resource allocation in anti-poverty interventions and to monitor and evaluate the effectiveness of specific policies, the measurement of poverty plays a crucial role (Alkire and Foster 2011a; Deaton 2016). Among the multidimensional poverty indices computed for a large number of countries, the most influential one is the global Multidimensional Poverty Index (MPI) (Alkire and Santos 2014).

The global MPI is an acute multidimensional poverty index, comprising three equally weighted dimensions (health, education, and living standard) and 10 indicators. The final index is computed by applying the counting approach proposed by Alkire and Foster (2011b) (hereafter AF method) and uses the simplest measure of this methodology: “the adjusted headcount ratio ( $M_0$ )”. The global MPI is calculated for over 100 developing countries and has been published by the UNDP since 2010 (UNDP 2010). Furthermore, it has been proposed to monitor progress towards SDG1 (Alkire and Jahan 2018).

The global MPI represents doubtlessly an impressive accomplishment; however, it does suffer from some drawbacks that have often been overlooked in the literature on multidimensional poverty analysis (Duclos and Tiberti 2016; Pogge and Wisor 2016). In particular, the global MPI pays no attention to the distribution of deprivations, ignoring thus inequality among the poor (Datt 2019; Rippin 2017), a serious defect of any poverty index (Sen 1976, 1992). As stressed by Sen (1992, 105), this weakness may “deflect anti-poverty policy by ignoring the greater misery of the poorer among the poor”.

Moreover, the global MPI uses the household as unit of analysis to assess who is poor and who is not; in other words, this index equates the poverty condition of the household with the poverty condition of all people belonging to the household (Espinoza-Delgado and Klasen 2018). Thus, it disregards intra-household inequalities. Moreover, as noted by Deaton (1997), poverty is a characteristic of individuals, not households.

Recently, the World Bank (2018) proposed a multidimensional poverty measure (MPM), consisting of six indicators, grouped in three dimensions: monetary standard of living, education, and access to basic services. The main summary measure is the multidimensional poverty headcount, i.e. the

share of population deprived in indicators whose weight adds up to one third or more. To address one of the limitations of the global MPI - the failure to account for the distribution of deprivations -, next to the headcount the World Bank (2018) tests two alternative poverty indices: the adjusted headcount measure (like for the MPI) and the distribution-sensitive measure developed by Datt (2019). However, throughout the 2018 report, the analysis concentrates almost exclusively on the multidimensional headcount ratio and in the 2020 report the figures obtained applying the two additional measures are neither commented nor reported (World Bank 2020). Finally, like the global MPI, the MPM is computed at the household level. An additional exercise is carried out to “individualize” it for adults in five countries (World Bank 2018). However, the final index is only partially individualised, as information on 70% of the deprivations is not collected at the individual level.

This paper proposes a new index of multidimensional poverty - called Global Correlation Sensitive Poverty Index (G-CSPI) - that overcomes some of the methodological shortcomings of the global MPI (and of the World Bank’s MPM), discussed previously. Unlike the process that generated these two global indices, large attention is devoted to the choice of dimensions; by adopting an expanded version of the constitutional approach (Burchi, De Muro, and Kollar 2014, 2018), we identify a minimum list of core dimensions, which are shared across the majority of constitutions. Then, our index employs an inequality-sensitive multidimensional poverty measure that can be decomposed into the three “I’s” of poverty: incidence, intensity, and inequality (Jenkins and Lambert 1997). Finally, the G-CSPI is an individual-based, rather than household-based index: specifically, it focuses on individuals 15–65 years of age. This allows, among other things, to examine intra-household differences in poverty among members within that age-range. Being centred on individuals and sensitive to inequality, the G-CSPI is coherent with the central overarching principle of the 2030 Agenda “leaving no one behind”. Thus, it has a great potential to adequately track progress in SDG1. To have a complete picture of multidimensional poverty for an entire society, however, the G-CSPI needs to be complemented by specific poverty indices for children and the elderly.

Using household data from the World Bank’s International Income Distribution Data Set (I2D2), we computed this index for more than 550 surveys: here, we present recent estimates for 104 countries. In a nutshell, the empirical results show that the index is highly robust to different specifications, and that, as expected, fragile countries experience the largest levels of multidimensional poverty.

The remainder of the paper is organised as follows. Section 2 illustrates the conceptual framework. Section 3 describes the database used and the methodology employed to compute the final index. Section 4 presents the figures of our index of multidimensional poverty. Section 5 contains the robustness analysis. Finally, the conclusions are included in Section 6.

## Conceptual Framework

Before measuring poverty, we need to have a clear understanding of what poverty is about. A conceptual framework should be at the centre of a rigorous measurement exercise in order to avoid the well-known problem of “measurement without theory” (Burchi and De Muro 2016; Koopmans 1947). The conceptual framework allows having a clear and explicit definition of the concept being measured and, in the case of multidimensional poverty, to identify the relevant dimensions and indicators.

There are, indeed, many approaches to poverty that do recognise its multidimensionality, such as the basic needs approach and the livelihood approach. We endorse Amartya Sen’s (1985, 1992, 2000) capability approach.<sup>1</sup> Based on this approach, poverty is defined as “capability deprivation”, a situation in which people lack the basic freedoms to pursue a valuable life. The capability approach “concentrates on deprivations that are intrinsically important”, while income or commodities – the key informational basis used in the monetary, livelihoods and basic needs approaches – are “only instrumentally significant” (Sen 2000, 87). It depicts people’s poverty experiences in the different life domains, rather than based on the potential means to prevent/escape poverty (Sen 1992). Moreover, by focusing directly on how people fare in the multiple life domains, it accounts for non-market attributes, i.e. characteristics such as education or social relations that people may value and for which markets are either non-existing or imperfect (Thorbecke 2007).<sup>2</sup>

Therefore, the ideal “evaluative space” of poverty measurement is that of capabilities (Sen 2000). Measuring capabilities is, however, extremely hard: this requires *ad hoc* surveys and so far, there have been few attempts only at micro scale. Therefore, we measure poverty in the space of functionings.

## Data and Methodology

### Data

We use the I2D2, a worldwide database drawn on nationally representative household surveys - such as the Household Budget Surveys and Living Standards Measurement Study Surveys - and consisting of a standardised set of demographic and socio-economic variables. Thanks to this database, we are able to focus on individuals rather households: specifically, on adolescents and adults in the age group between 15 and 65. This choice is supported by overwhelming literature that emphasises that children and elderly people value different dimensions of poverty and thus experience poverty differently from people in other life cycles (Biggeri et al. 2006; Lloyd-Sherlock 2002).<sup>3</sup>

## ***Dimensions of Poverty***

We adopt a new method to derive a list of poverty dimensions, which consists in the extension of the “Constitutional Approach”, proposed by Burchi, De Muro, and Kollar (2014, 2018). These authors combine Sen’s capability approach and Rawls’ method of political constructivism, and use the constitution and its interpretative practices as an ethically suitable informational basis for identifying publicly justifiable poverty (and well-being) dimensions. The central argument is that the basic norms in which people have been socialised are the source of shared ideas in a political community and, therefore, should provide the starting point of any exercise of selection of poverty dimensions.

The constitutional approach overcomes some of the problems present in the other potential approaches, namely the public consensus, the survey-based and the participatory approach (Alkire 2007). We argue that its value added emerges particularly clear when the purpose is to compare multidimensional poverty across several countries.<sup>4</sup> Through the public consensus approach, a list of dimensions is generated through “some arguably legitimate consensus building process at one point in time” (Alkire 2007, 102), such as with the MDGs and the 2030 Agenda. This approach suffers from a *status quo* bias since the contents of this agreement are not re-discussed and actualised, but taken as valid forever. The constitutional approach, instead, starts from institutionally embedded norms, which are not taken at face value, but actualised, re-interpreted and re-elaborated through moral guidance.

The constitutional approach is also preferable to the survey-based approach since it focuses on the structural values of a society, and not on what people may indicate as priority areas for action in survey questions. Finally, dimensions can be extracted through participatory methods, such as focus groups (Narayan et al. 2000; Wisor et al. 2016). On paper, the participatory approach is probably the one that most closely resembles Sen’s (2004) idea of an in-depth public consultation to obtain a shared list of valuable dimensions. However, power imbalances and educational disparities, in particular, can undermine the normative validity of the final outcome. The constitutional approach, instead, does not face these risks.

Moreover, the constitutional approach has the advantage of not requiring the collection of additional data. However, not all constitutions are valid sources of dimensions: they have to satisfy at least some basic criteria. Procedural criteria would refer to the process that led to the finalisation of the constitution, the degree and quality of public participation and how conflicting views were dealt with. The substantive minimum requirement for the constitutional norms is that they treat people with equal respect and as autonomous citizens (Burchi, De Muro, and Kollar 2018). Clearly, the presence of democratic institutions is a prerequisite for a national constitution to be a source of ethically

sound dimensions of poverty. Another important condition is that the constitution is active since long time.

So far, the constitutional approach has been used only for single-society analysis (Burchi, De Muro, and Kollar 2018). Thus, one challenge is to utilise it to derive valuable dimensions across different countries. We envisage two potential routes. The first is to use a broader idea of an international constitution, which goes beyond the definition of fundamental law of a country. However, at the moment, we do not see an adequate source for international comparisons. A second way is to examine several constitutions that can meet most of the requirements and see whether there is a convergence towards at least a minimal list of dimensions. We follow this second route. But, since reviewing all (suitable) world constitutions and, especially, analysing in detail all the relevant interpretative practices to go beyond the face value of the constitutional text is not a feasible task, we decided to integrate the list obtained in this way with lists obtained with different approaches. Here below we report all sources used for each approach.

**a) Constitutions.** Table 1 present the list of constitutions examined. In the selection of the countries, we looked at the constitutions that were more suitable to identify poverty dimensions and, at the same time, we tried to have perspectives from different world regions. The in-depth explanation of country selection is provided in Appendix A1. Finally, it is important to highlight once more that the analysis of these constitutions has the broader scope of identifying valuable dimensions of poverty around the world. Thus, the final list will be used for all the countries where data are available.<sup>5</sup>

**b) Public consensus approach.** The international agreements/processes included in our analysis are: the MDGs, the SDGs, the International Covenant on Social and Economic Rights (ICSECR) and the International Covenant on Civil and Political Rights (ICCPR). The MDGs emerged out of the Millennium Declaration, signed in 2000 by 189 world leaders. They contributed substantially to shape the international agenda. The SDGs, instead, are the results of a longer and more participatory debate. However, the fact that multiple players were allowed to provide inputs, without a clear, coherent framework, led to a very long list of goals and targets, which is not useful for identifying

**Table 1.** List of constitutions used to derive poverty dimensions.

World region	Country
East Asia	Japan, Korea
South Asia	India, Bhutan
Central Asia	Mongolia
North Africa	Egypt, Tunisia
Sub-Saharan Africa	South Africa, Namibia
Europe	EU-15
Central America	Mexico, Costa Rica
South America	Brazil, Peru

relevant poverty dimensions (Klasen 2015). The ICSECR and the ICCPR, instead, are two multilateral treaties with more than 70 signatories.

**c) Participatory studies.** Two main initiatives used participatory methods to understand which are, according to the poor, the constitutive domains of poverty. One is the World Bank’s “Voices of the Poor” initiative (Narayan et al. 2000), which involved more than 20,000 poor people in 23 countries. The other is a study conducted by researchers at the Australian National University together with several partners (Wisor et al. 2016).

**d) Surveys.** The main survey used here is “My World”, a large, cross-country survey carried out as a preparation for the SDG consultation (UNDG 2013). More than one million people in 88 countries around the globe were asked about the world they want. We also examined the World Values Survey and other surveys conducted at lower scale (e.g. Clark 2005).

The findings are striking (Table 2). Regardless of the approach used, three dimensions are valued much more than the others: “holding a fulfilling job”, “having adequate education/knowledge”, and “being in a good health status”. The direct implication is that a multidimensional index of poverty should *ideally* incorporate these dimensions.

We can identify a second group of dimensions, which includes decent housing, access to food/nutrition, access to water, social security, political participation, access to sanitation, and living in a good environment.<sup>6</sup> Participatory and survey-based approaches assign more relevance to housing than the other two methods. Constitutions and surveys, instead, assign less importance to access to food. Political participation, instead, is a fundamental capability using the constitutional approach,<sup>7</sup> while it is less relevant using the other approaches. Finally, access to sanitation is not frequently mentioned in the constitutions, while it plays a relevant role when we employ the other methods.

We then have to identify a feasible list based on objective and data availability (Robeyns 2003). Given our dataset and the objective of measuring multidimensional poverty to compare countries across the globe, we finally selected three dimensions: 1) education/knowledge, 2) fulfilling work/employment, and 3) access to drinkable water and sanitation. This allows us to include three valuable dimensions and, at the same time, cover a large number of countries. This way, we incorporate two of the three main dimensions. Unfortunately, comparable information on health is missing in many countries; however, access to drinkable water and sanitation is taken also as a proxy for health (see below).

**Table 2.** List of relevant dimensions based on the combination of the four approaches.

Group	Dimensions
1	Fulfilling work, education, health
2	Decent housing, access to food/nutrition, social security, access to water, political participation, access to sanitation, good environment



In the following paragraphs, we elaborate further on the justification of the selected dimensions.

### ***Fulfilling Work***

Having “fulfilling” work or, as highlighted by the International Labour Organization (ILO), a “decent work”, is intrinsically as well as instrumentally important for poverty. All the constitutions considered here recognise the importance of work, which goes beyond the wage aspect. This is particularly the case of India, South Africa, 12 EU countries, and the four Latin American countries. Moving to the public consensus approach, in 2007 a new target focusing on productive employment and decent work was introduced in MDG 1. Since then, the international community has put work at the centre of the development agenda (SDG 8). Finally, employment results as a fundamental dimension also in the participatory studies and surveys.

### ***Adequate Education/Knowledge***

All the constitutions emphasise the importance of education, and recognise the role of the state in promoting the right to education. In countries like Bhutan, Egypt, Tunisia, Brazil, and Peru, the constitutions go far beyond the view of education as an instrument for the economy. For example, those of Peru and of the Kingdom of Bhutan refer explicitly to the potential of education for human flourishing. Many constitutions – India, Bhutan, Japan, Tunisia, Mexico, and Peru – also contain norms regarding a free and mandatory access to education up to a certain level.<sup>8</sup> Education is also fundamental in the MDGs (Goals 2 and 3) and SDGs (Goal 4) frameworks as well as in all surveys.

### ***Access to Safe Drinkable Water and Adequate Sanitation***

Access to water and sanitation have an intrinsic relevance. International treaties and consensus-building processes (e.g. MDG 7 and SDG 6) emphasise their importance. Also based on participatory studies and surveys, these dimensions result as fundamental. Only four constitutional texts (in Egypt, Tunisia, South Africa, and Mexico) and one interpretative norm (the 1999 Supreme Court<sup>7</sup> judge in India), instead, highlight explicitly the value of access to safe water and sanitation. This is partly because these basic needs are satisfied in higher income countries and, therefore, not explicitly mentioned in the constitutions.

These two dimensions were included in this work because they are also instrumentally relevant and closely related to health, the crucial dimension for which we have no data. It is estimated that every day about 5 million people, dominantly children, die from diseases caused by poor-quality water supplies (Fogden 2009). According to the World Health Organization (WHO), 88% of diarrheal disease is attributed to unsafe water supply, bad sanitation and poor hygienic conditions.<sup>9</sup> Given that diarrhea is the second cause of

death for preschool children these figures are remarkable. Other studies (Fink, Günther, and Hill 2011; Fogden 2009) point to the key role played by access to safe drinking water and adequate sanitation in preventing other diseases, such as cholera, malaria, and dengue, and in reducing mortality rates. We argue, therefore, that our indicators can be regarded as good proxy measures for the capability “being free from preventable diseases”. Finally, in line with the formulation of the SDG 6 and given their strict connection with the missing dimension of health, access to water and access to sanitation were combined into one single dimension.

### **Weighting Structure**

Table 3 reports the weights, indicators and thresholds used to calculate the G-CSPI for each of the three dimensions. We identify the weights on normative grounds as the weights reflect the theoretical relevance of the different dimensions for poverty. Were citizens socialised in a country where certain values were deemed more important than others? Do the citizens of a country value more education, health or nutrition? These are the type of questions we have in mind when reflecting on weights.

We assign equal weights to the three dimensions because based on the constitutional approach, as well as the other methods there is no clear evidence of which of the three dimensions is more relevant. However, this hypothesis works only as long as we consider deprivations in access to safe drinking water and adequate sanitation as proxies for health deprivations rather than dimensions *per se*. Therefore, for the robustness analysis, we use alternative weighting schemes, starting from the case in which education and employment carry higher weights than access to drinkable water and sanitation.

### **Indicators and Thresholds**

#### **Indicators of “Fulfilling Work”**

We measure this dimension by mixing information on two variables: “labor status” and “employment status”. Based on the first one, in line with the ILO

**Table 3.** Summary of choices for the computation of the G-CSPI.

Dimension	Weight	Indicator	Deprived if ...
Fulfilling work	1/3	Employment status	Person is unemployed & seeking a job, or is employed in a low-pay/low-quality sector
Adequate education/ knowledge	1/3	Literacy Years of education Educational level	Person is unable to read, to write or both Person has less than 4 years of schooling Person has no education
Access to water & sanitation (health)	1/3	Access to safe drinkable water and adequate sanitation	Person has no access to drinkable water and no access to adequate sanitation

definition,<sup>10</sup> people are classified as “employed” if they worked at least one hour during the seven days preceding the survey, and “unemployed” if they were not working but actively seeking a job. The last category is composed of people who are not in the labour force, i.e. those without a job and not actively seeking it.

We classified as employment-deprived all “unemployed” individuals, while those “non-in-labor force” were classified as non-deprived, bearing in mind that our sample contains only individuals between 15 and 65 of age. For the “employed” individuals, we then looked at their employment status. The dataset distinguishes 5 categories: paid employee, non-paid employee, employer, self-employed, and other worker. By construction, in all surveys, individuals classified as “non-paid employees” or “self-employed” are those with lower pay and lower quality employment. Therefore, these individuals were also classified as deprived in the employment dimension.<sup>11</sup>

### *Indicators of “Adequate Education”*

The minimum outcome of a good education system is to have a large proportion of the population that is literate. People who are able to both read and write with understanding are considered literate (and non-deprived in education), while those who cannot perform at least one of the two activities are classified as illiterate (and education-deprived). For a few countries of our final sample, however, we do not have sufficient information on literacy, but we have information on (completed) years of formal education. Based on a sample of countries with data on both literacy and years of schooling, we found that in 92% of the cases people having at least four years of education are also literate. We therefore used this threshold to create a new variable for those surveys in which we do not have direct information on literacy: individuals with less than 4 years of schooling are classified as deprived, while those with at least 4 years of schooling are non-deprived in the knowledge domain. Finally, in the very few cases, where a survey lacked sufficient information on both literacy status and years of schooling, we utilised the variable “educational level”: an individual who has not completed primary education is considered education-deprived.

### *Indicators of “Access to Safe Drinkable Water and Adequate Sanitation”*

We treat as deprived in this dimension all individuals with access to neither safe drinkable water nor adequate sanitation. Conversely, all people with access to at least one of them are considered non-deprived. This is motivated by the choice of having a measure of acute multidimensional poverty and by the evidence that water and sanitation are often poorly correlated (Bennett 2012). In the robustness analysis, also individual with access to only one facility are considered as deprived.

While information on education and work is collected at the individual level, that on access to drinkable water and adequate sanitation is collected at the household level and then the same value is imputed to all household members. In line with several studies (Burchi et al. 2019; Espinoza-Delgado and Klasen 2018; Vijaya, Lahoti, and Swaminathan 2014), we treat such services as true public goods (non-rival and non-excludable).

### ***An Inequality-sensitive Framework for Estimating Multidimensional Poverty with Ordinal Data***

The framework used in this paper is based on the approach proposed by Rippin (2013, 2017), a counting approach that is sensitive to the inequality among the multidimensionally poor people. It entails a two-stage procedure: the identification stage that assigns different degrees of poverty severity to individuals (or individual weights), using a “fuzzy” identification function, and the aggregation stage that aggregates individual poverty characteristics (deprivation scores) into one single multidimensional poverty index. Before describing this procedure, let us first present some general notations and definitions.

#### ***General Notations and Definitions***

Let  $\mathbb{R}_k$  denote the Euclidean  $k$ -space,  $\mathbb{R}_+^k \subset \mathbb{R}^k$  the non-negative  $k$ -space and  $\mathbb{N}$  the set of positive integers. Let  $N = \{1, \dots, n\} \subset \mathbb{N}$  represent the set of  $n$  individuals and  $D = \{2, \dots, d\} \subset \mathbb{N}$  the set of  $d$  poverty dimensions; let  $w_j$  denote the weight of dimension  $j$ , with  $w_j > 0 \forall j = 1, \dots, d$  and  $\sum_{j=1}^d w_j = 1$ . Let  $x = \{x_{ij}\}$  be the  $n \times d$  matrix of achievements where  $x_{ij} \geq 0$  is the achievement of individual  $i = 1, \dots, n$  in dimension  $j = 1, \dots, d$ . Consequently,  $X = \{x \in \mathbb{R}_+^{nd} : n \geq 1\}$  describes the domain of matrices under consideration. Further, let  $z_j$  denote the deprivation threshold of dimension  $j$  so that individual  $i$  is deprived in dimension  $j$  whenever his or her achievement falls short of the respective threshold, i.e. whenever  $x_{ij} < z_j$ . Let  $z \in \mathbb{R}_{++}^d$  represent the vector of chosen deprivation thresholds and  $Z$  the set of all possible vectors of deprivation thresholds. Since in this paper we follow an ordinal approach, considering the nature of the selected dimensions, the achievement matrix  $[x = \{x_{ij}\}]$  can be transformed into a *weighted deprivation matrix* that we will denote with  $g^0 = [g_{ij}^0]$ . Thus,  $g^0$  represents the  $n \times d$  matrix of weighted deprivations where  $g_{ij}^0 = w_j$  in case  $x_{ij} < z_j$  and  $g_{ij}^0 = 0$  otherwise. In other words, the  $ij$ th entry of the deprivation matrix is equal to the weight of dimension  $j$  in case individual  $i$  is deprived in dimension  $j$  and 0 otherwise. From  $g^0$  we can

define the *weighted deprivation counts* vector  $c$  so that  $c_i = \sum_{j=1}^d g_{ij}^0$  provides the sum of weighted deprivations suffered by individual  $i$ .

### **The Identification Stage: The “Fuzzy” Identification Function**

In the literature on multidimensional poverty measurement with ordinal variables, we find two types of identification functions ( $\varphi$ ): “discrete” identification functions and “fuzzy” identification functions (Espinoza-Delgado and Silber 2018, 2021; Silber and Yalonetzky 2014). “Discrete” identification functions have been used in almost all applications, including the global MPI; these types of functions follow the crisp set logic of a standard poverty line and share, therefore, the limitation of dichotomising (0–1) the entire population into multidimensional poor and multidimensional non-poor by means of the so-called multidimensional poverty line. This causes a substantial loss of information (Betti et al. 2008; Neff 2013). The “fuzzy” identification functions, unlike the “discrete” ones, avoid a strict poor/non-poor dichotomy and the establishment of an arbitrary multidimensional poverty line (Betti et al. 2008); these consider the entire distribution of deprivations.

A discrete identification function ( $\varphi_{AF}$ ) establishes a single abrupt and arbitrary “hard” cut-off ( $k$ ) and dichotomises (0–1) the *weighted deprivation counts* vector ( $c$ ), comparing the *individual weighted deprivation count* ( $c_i$ ) with  $k$ . If  $c_i \geq k$ , the individual “ $i$ ” is considered to be multidimensionally poor, and  $\varphi_{AF}$  attaches a value of 1 to this individual; on the contrary, if  $c_i < k$ , the individual “ $i$ ” is regarded to be multidimensionally non-poor, and  $\varphi_{AF}$  assigns a value of 0 to him/her. It should be noted that since the global MPI uses a “dual cut-off identification method” that converts the *weighted deprivation counts* vector ( $c$ ) into a binary variable (0–1),<sup>12</sup> it employs a “discrete identification function”; moreover, this method, and so the global MPI, censors below  $k$  the distribution of *weighted deprivation counts*, disregarding thus valuable information on the distribution of deprivations. It also implicitly assumes that up to  $k$  dimensions are “perfect substitutes”, while it considers the same dimensions as “perfect complements” from  $k$  onwards (Rippin 2017), a difficult assumption to justify theoretically (Espinoza-Delgado and Silber 2018, 2021).

In this paper, we prefer to adopt a “fuzzy” function that distinguishes individuals according to their degree of multidimensional poverty, that is, according to the number of deprivations they suffer, instead of dividing the population into only two groups: multidimensionally poor individuals and multidimensionally non-poor individuals. We therefore understand multidimensional poverty as a “matter of degree” and not an “all or nothing” condition and consider in the analysis the entire distribution of deprivations (Betti et al. 2008; Chiappero-Martinetti 2006). Specifically, we employ the simplest case of the “fuzzy” identification function suggested by Rippin (2013, 2017), which can

be defined as follows:

$$\varphi_f(x_i; z; w) = \begin{cases} 1 & \text{if } \left[ \sum_{j=1}^d g_{ij}^0 \right] = 1 \\ \left[ \sum_{j=1}^d g_{ij}^0 \right] & \text{if } 0 < \left[ \sum_{j=1}^d g_{ij}^0 \right] < 1 \\ 0 & \text{if } \left[ \sum_{j=1}^d g_{ij}^0 \right] = 0 \end{cases} \quad (1)$$

where  $\left[ \sum_{j=1}^d g_{ij}^0 \right] = c_i$ .<sup>13</sup> That is, an individual's degree of poverty severity is simply the sum of his or her weighted deprivations. It should be noted that this function is considered to be “fuzzy” because, unless  $c_i = 0$  or  $c_i = 1$ , each individual is “somewhat” multidimensionally poor as soon as he or she is deprived in one poverty domain, although the final degree depends on the total number of deprivations suffered by this individual (Bérenger 2017; Espinoza-Delgado and Silber 2018, 2021; Silber and Yalonetzky 2014).

It is worth stressing that this “fuzzy” identification function has two main advantages when compared to “discrete” identification functions. First, it keeps the strength of the union approach's argument that all poverty dimensions are essential; if some of them were not, why would they be included in the poverty measurement exercise in the first place? This is the very argument of the “Strong Focus” axiom that Alkire and Foster (2011b) require their  $M_0$  class of poverty indices to satisfy. Second, the function does not rely on an additional cut-off ( $k$ ) that ushers in additional (arbitrary) choices.

Once we have produced  $\varphi_f(x_i; z; w)$ , prior to the aggregation stage, we define an individual multidimensional poverty function  $p_i(x_i; z; w)$  that captures the breadth of multidimensional poverty experience  $[B(x_i; z; w)]$ , in line with the literature on multidimensional poverty measurement with ordinal data (Espinoza-Delgado and Silber 2018, 2021; Silber and Yalonetzky 2014; Rippin 2017), in addition to the “fuzzy” identification function. In this regard, we use the *individual weighted deprivation count* as the breadth function, which is the one used by Alkire and Foster (2011b); therefore, we define the individual multidimensional poverty function as follows:

$$\begin{aligned} p_i(x_i; z; w) &= \varphi_f(x_i; z; w) * B(x_i; z; w) = [c_i(x_i; z; w)][c_i(x_i; z; w)] \\ &= [c_i(x_i; z; w)]^2 \end{aligned} \quad (2)$$

In other words, the fuzzy identification function acts as a “weighting” function and multiplies the “breadth” of multidimensional poverty to produce the individual multidimensional poverty function.

### The Aggregation Stage

To solve the aggregation problem and produce our multidimensional poverty measure, called CSPI, we simply compute the average of the individual multidimensional poverty functions. The CSPI is a very simple representative measure of the  $P_{CS}^y$  class of multidimensional poverty measures proposed by Rippin (2013, 2017). The index is defined as follows:

$$CSPI = \frac{1}{n} \sum_{i=1}^n [c_i(x_i; z; w)]^2 \quad (3)$$

Therefore, the CSPI is simply the squared sum of weighted deprivations suffered by the multidimensionally poor individuals divided by the maximum possible number of weighted deprivations.

The CSPI satisfies a number of appealing axioms such as Anonymity, Monotonicity, Principle of Population, Strong Focus, Normalization, Subgroup Decomposability (Rippin 2017; Bérenger 2017), as well as the property of Sensitivity to Inequality Increasing Switches (SIIS), which  $M_0$ , and therefore the global MPI, due to the dual cut-off, does not satisfy.<sup>14</sup> Furthermore, considering that the CSPI is the result of a clearly separated two-stage calculation (identification and aggregation), which allows the index to be additive in the aggregation stage, it is possible to decompose it partially by dimension. However, it should be noted that this may be seen as a disadvantage of the CSPI as compared to the global MPI ( $M_0$  measure), which can be directly and fully decomposed to examine the absolute (or relative) contribution of each dimension to the overall index.

On the other hand, the CSPI has a number of advantages compared to the global MPI ( $M_0$ ). First, unlike the  $M_0$ , the CSPI can be broken down into all three I's of poverty: incidence (expressed by the headcount, H), intensity (expressed by the average deprivation share among the poor, A) and inequality (expressed by a Generalized Entropy measure of inequality, GE):  $CSPI = HA^2[1 + 2GE_2(c)]$ .<sup>15</sup> Thus, any poverty reduction policy that targets the CSPI has to automatically deal with all three I's of poverty. In contrast, inequality is not a natural product of the  $M_0$  and can only be calculated separately.

Second, as one would expect, the CSPI increases whenever there is a transfer from a poor to a less poor individual. To the contrary, in these situations, the  $M_0$  either does not change (in case both individuals remain poor after the transfer) or even decreases (in case the receiving person falls below the cut-off k). Since it treats all poverty dimensions as independent (at least in the aggregation step),  $M_0$  violates this fundamental property that, according to Sen (1976), any reasonable poverty index should satisfy.

Third, given that the average poverty intensity in the  $M_0$  is truncated from below, any variation between countries and over time is almost entirely

driven by the headcount (Dotter and Klasen 2014). In contrast, the average poverty intensity in the CSPI is not truncated and, therefore, provides much more variation and, consequently, more information.

## Empirical Analysis

We were able to compute the G-CSPI for more than 550 household surveys since 1980s. Next to the point estimates, for each country, we calculated the bootstrapped standard errors, following the bootstrap estimate of the standard errors and the bootstrap percentile method, with 100 stratified bootstrap replications, proposed by Efron (1981). This way, we know how much each point estimate varies around its true value. The standard errors are reported in Appendix A2.

For a sound comparison of poverty levels across countries, we present here only the most recent country estimates as long as the surveys were conducted after 1999. The empirical analysis, thus, relies on a sample of 104 countries.<sup>16</sup> The total population in the age group 15–65 years in these countries corresponds to about 63.5% of the world population in that age group around 2007–2008. Within this group of countries, the population in the age group 15–65 years, accounts, on average, for about 62% of the whole population.

Based on the World Bank classification, all the countries except for three were either low- or middle-income countries in the survey year (Table 4). The sample covers dominantly sub-Saharan Africa (38.46%), followed by Europe and Central Asia (20.19%), Latin America and the Caribbean (17.31%), and East

**Table 4.** Economic profile of the countries used for the calculation of the G-CSPI.

Income classification	Number of countries	Percentage of the sample
High income	3	2.88
Low income	30	28.84
Lower middle income	43	43.13
Upper middle income	28	26.92
Total	104	100

**Table 5.** Geographical coverage of the countries used for the calculation of the G-CSPI.

World region	Number of countries	Percentage of the sample	Population (15–65 y.o.) coverage *
East Asia & Pacific	14	13.46	84.0%
Europe & Central Asia	21	20.19	50.0%
Latin America & Caribbean	18	17.31	64.8%
Middle East & North Africa	5	4.81	37.9%
South Asia	6	5.77	24.9%
Sub-Saharan Africa	40	38.46	91.8%
Total	104	100	

\* For each region this is calculated by dividing the population in the 15–65 years age group in our sample of countries by the total regional population. As surveys were carried out in different years, for the denominator we used the population in the average year in which the surveys were conducted in the region.



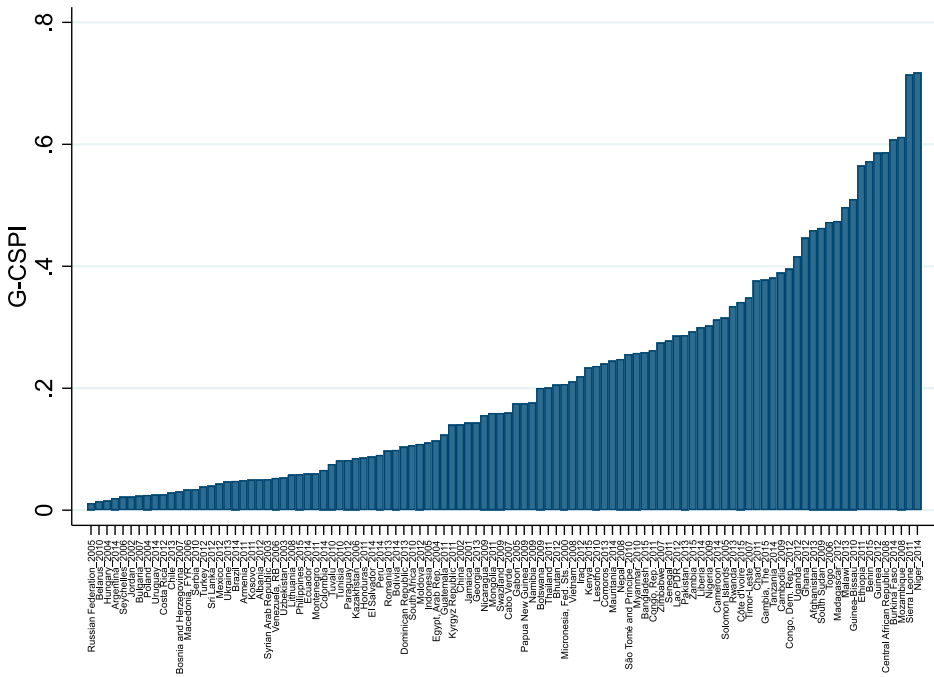


Figure 1. G-CSPI values, by country. Source: our elaborations on I2D2 database.

Asia and the Pacific (Table 5). Six out of the eight countries located in South Asia are part of the sample: however, since the largely most populous country, India, is missing, the population coverage in the region is low.<sup>17</sup> From all the points of view is the Middle East and North Africa region under-represented, with only five of the potential 21 countries and a coverage of 38% of the population.

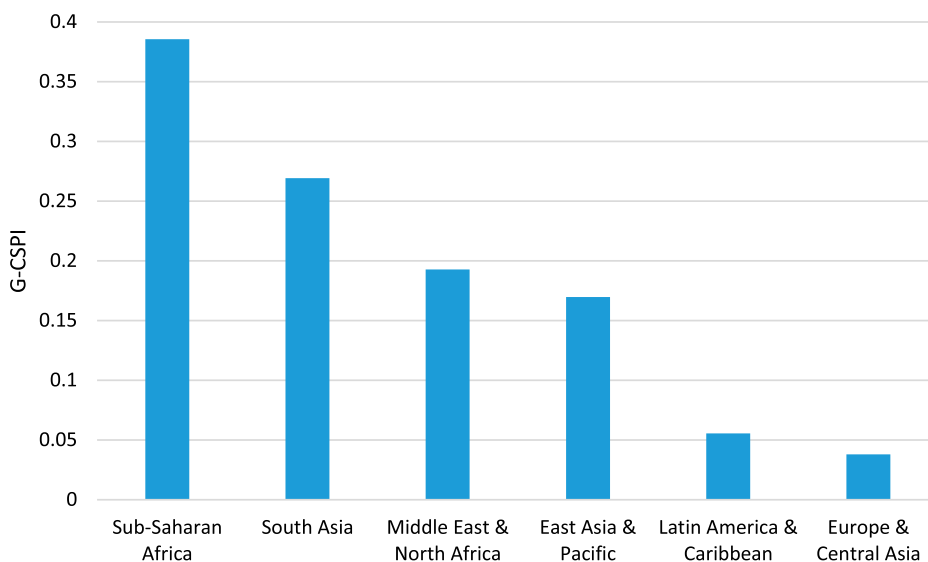
Figure 1 reports the values of the G-CSPI. As expected, the countries with the highest levels of multidimensional poverty are fragile states, namely Niger, Sierra Leone, and the Central African Republic, together with other low-income countries from sub-Saharan Africa, such as Mozambique, Guinea, Benin, and Ethiopia. To the opposite, the lowest values are found in Central-East Europe and Latin America. This appears even clearer in Figure 2, which presents the population-weighted mean G-CSPI by region.<sup>18</sup>

### Robustness Analysis

This section tests the robustness of our results to alternative choices by means of correlation and concordance analysis.

#### Sensitivity to Different Variable Specifications and Thresholds

For the robustness analysis, we first modified the measurement of health deprivations, by changing the dimensional poverty line. All people without access to



**Figure 2.** Population-weighted mean G-CSPI values, by region. Source: our elaborations on I2D2 database.

Notes: weights are calculated based on the population of the relevant age-group (15–65).

drinkable water or sanitation are now considered poor in this dimension: therefore, multidimensional poverty with this adjustment increases for all countries. As highlighted in [Table 6](#), both the correlation in G-CSPI values (Pearson) and rankings (Spearman) between main and alternative measures is very high, 0.961. A bit lower (0.841) is the Kendall Tau-b coefficient, which is computed by comparing each pair of countries in a pair of rankings.

The revised education variable is obtained with the same (flexible) approach used for the main estimates by using a more stringent condition on population coverage: information on literacy, or alternatively years of schooling or, finally, educational level should be available for 80% of the sample population (instead of 66.66%). Consequently, the sample of countries falls from 104 to 85. As expected, all the correlation coefficients indicate a very high correlation between the main and the revised G-CSPI value.

**Table 6.** Correlations between main G-CSPI and G-CSPI with alternative variables.

Pair of rankings compared	Correlation coefficient	Value	Number of countries
G-CSPI value vs. G-CSPI with revised health variable	Pearson	0.961	104
	Spearman	0.961	104
	Tau-b	0.841	104
G-CSPI value vs. G-CSPI with revised education variable	Pearson	0.991	85
	Spearman	0.991	85
	Tau-b	0.965	85
G-CSPI value vs. G-CSPI with revised labour variable	Pearson	0.991	80
	Spearman	0.989	80
	Tau-b	0.922	80

**Table 7.** Correlations between main G-CSPI and G-CSPI with alternative weights.

Pair of rankings compared	Correlation coefficient	Value
G-CSPI value with equal weights vs. G-CSPI weights: work (0.4), education (0.4), health (0.2)	Pearson	0.988
	Spearman	0.987
	Tau-b	0.918
G-CSPI value with equal weights vs. G-CSPI weights: work (0.2), education (0.4), health (0.4)	Pearson	0.994
	Spearman	0.992
	Tau-b	0.928
G-CSPI value with equal weights vs. G-CSPI weights: work (0.4), education (0.2), health (0.4)	Pearson	0.988
	Spearman	0.990
	Tau-b	0.922

Finally, the alternative indicator of fulfilling work is constructed combining information on the labour status together with information on the type of occupation (instead of employment status). All people unemployed or employed in “elementary occupations” or in “skilled agriculture, forestry and fishery” were considered as poor in this dimension. The adjusted G-CSPI was calculated for 80 countries: the correlation with the main G-CSPI is very high (0.991) based on Pearson and Spearman coefficients, and 0.92 based on Kendall Tau-b coefficient. In conclusion, we can safely state that the G-CSPI estimates are robust to changes in the dimensional indicators.

### ***Sensitivity to Different Weights***

To further test the sensitivity of our index, we changed the weights. First, we assigned a lower weight (0.2) to access to drinkable water and sanitation as compared to decent work (0.4) and education (0.4). Then, following the same scheme, we applied the lower weights to work and finally to education.

The results of the correlation analysis are provided in [Table 7](#). Regardless of the weighting scheme, the Pearson and Spearman coefficients are at least 0.988 and Kendall’s Tau-b equal to 0.918 or higher, indicating overall very strong correlation between the main estimate of G-CSPI and the alternative G-CSPIs. We also performed an analysis of concordance among the four ranks: The Kendall’s coefficient of concordance is 0.985 and the Friedman’s test rejects the null hypothesis of no concordance among the four G-CSPIs at 0.01% level.

### **Conclusions**

There is nowadays agreement that poverty is a multidimensional phenomenon. The global MPI, the most famous international index of multidimensional poverty, has provided a great contribution to the debate on the measurement of multidimensional poverty. However, this index suffers from some weaknesses, such as the impossibility to take into account inequality among the poor and intra-household disparities.

In this paper, we proposed a new international index of multidimensional poverty, the G- CSPI, which has the following strengths:

1. It is grounded on Sen's capability approach, justified as the most adequate conceptual framework to conceptualise and measure poverty;
2. It encompasses three dimensions of poverty: decent work, education and access to safe drinking water and adequate sanitation (also proxy for health). These three dimensions largely overlap with the list of ideal dimensions obtained by expanding an innovative approach called constitutional approach. However, given data constraints, including a measure of decent work came at the cost of not including direct health measures;
3. The unit of analysis is the individual (and not the household) in the 15–65 age group. Children younger than 15 and people older than 65 are likely to value different dimensions of poverty: thus, separate indices of multidimensional poverty for these groups should be developed to obtain a full picture of poverty for the countries examined;
4. It employs a poverty measure, which accounts not just for poverty incidence and intensity (as the global MPI) but also for inequality among the poor.

Thanks to the massive I2D2 database of harmonised household surveys, we were able to compute the G-CSPI for more than 550 surveys. In this paper, we concentrated only on the most recent G-CSPI estimates for 104 countries. The results highlight that, as expected, mostly fragile states are among those with the highest poverty scores. Moreover, it appears clear that multidimensional poverty is mainly concentrated in sub-Saharan Africa.

We then examined the robustness of the G-CSPI to changes in the dimensional indicators and in the weighting schemes, by means of correlation and correspondence analysis. The coefficients were always very high, supporting the robustness of the index.

In conclusion, we believe that this new index provides a substantial contribution to the literature on poverty measurement and could be an important tool to track progress towards the achievement of SDG 1. Moreover, the considerable amount of data generated - including the extensive disaggregated poverty results not examined in this paper - allows investigating trends and horizontal inequalities in poverty.

## Notes

1. This approach is centered on two main concepts: functionings and capabilities. Functionings consist of people's achievements; capabilities, instead, reflect what they can be and do in their life.
2. Another important strength of the capability approach is that, by focusing directly on people's deprivations, it accounts for the role of "conversion factors" (Sen 1985).

Indeed, the relationship between income/commodities and functionings/capabilities is mediated by individual (age, gender, health), social (law, social norms, public policies), and environmental factors (climate) (Robeyns 2005).

3. Another important point is that, even concentrating on the same dimensions, different indicators would be required. With reference to the dimensions and indicators finally adopted in the G-CSPI (see Section 3.2 and 3.4), for example, literacy should be replaced by enrolment/attendance in school for children above 6, while the problem would still remain for the youngest children. Even more problematical is the dimension of decent work, given that children below 15 are hardly in any place of the world allowed to work and individuals above 65 are often retired. One option would have been to impute to children information about the work of the household head or both parents, but we preferred not to do it as this would highlight only the instrumental (and in particular monetary) role of work. For the future, we consider the possibility of constructing specific measures for children and the elderly, using different indicators and integrating our G-CSPI with these measures in order to have a complete poverty profile for the countries examined, in line with the proposal of Abdu and Delamónica (2018).
4. For an in-depth discussion on the differences between the constitutional approach and the other approaches used in the literature, see Burchi, Rippin, and Montenegro (2020).
5. For some of the countries whose constitutions were used to detect the key dimensions of poverty we do not have yet reliable estimates of multidimensional poverty.
6. Having decent housing, access to water, food and sanitation are indicators of access to resources: however, as stressed by Alkire (2008), they can be used as proxy for functionings.
7. However, in many constitutions political participation mainly consists of voting.
8. It is important to stress again that the constitutional approach is used only to identify the basic dimensions of poverty and their weights, and not the indicators and thresholds. Therefore, for example, for education we do not use specific country-level thresholds (e.g., completion of primary school) depending on the contents of the constitutional norms.
9. Source: [http://www.who.int/water\\_sanitation\\_health/publications/factsfigures04/en/](http://www.who.int/water_sanitation_health/publications/factsfigures04/en/).
10. See: <http://laborsta.ilo.org/applv8/data/c2e.html>
11. While the I2D2 dataset contains also information on working hours, wage, and duration of unemployment, these data are missing for many countries.
12. Specifically, the global MPI adopts the AF method, which uses a first cut-off (threshold) within each dimension (indicator) and a second one ( $k$ ) across dimensions (indicators) to identify the multidimensionally poor household (Alkire and Foster 2011b). However, no method exists from which the second cut-off could be derived: its choice is arbitrary.
13. Note that  $g_{ij}^0$  and  $c_i$  do no longer depend on  $k$ , as the fuzzy identification method is utilized instead of the dual cut-off method. The general formulation of the “fuzzy” identification function suggested by Rippin (2013, 2017) is:  $\varphi_f(x_i; z; w) = \left[ \sum_{j=1}^d g_{ij}^0 \right]^\gamma = [c_i]^\gamma$ ; therefore, the shape of the function depends on the correlation (relationship) among the poverty dimensions (the value of  $\gamma$ ). In case the dimensions are regarded to be complements ( $0 < \gamma < 1$ ),  $\varphi_f$  takes a concave shape; on the other hand, if the dimensions are considered to be substitutes ( $\gamma > 1$ ),  $\varphi_f$  takes a convex shape. An empirical illustration of how the function performs can be found in Espinoza-Delgado and Silber (2021).

14. Overall, the idea of the SIIS is that a switch of attributes that increases (reduces) the number of deprivations suffered by the individual with higher (lower) initial deprivation should not decrease poverty in case the attributes are substitutes. In the case of complements, the final effect of an inequality-increasing switch on the poverty index should depend on the importance attributed to distributive justice considerations as well as on the degree of complementarity between the respective attributes. It should be noted that the dual cut-off identification method causes the adjusted headcount ratio ( $M_0$ ) not to satisfy, even in its weakest form, the SIIS axiom. In other words, if an inequality increasing switch occurs between two multidimensionally poor individuals, and the less poor person is lifted out of poverty as a consequence of the switch,  $M_0$  will not increase no matter what the relationship between the dimensions/indicators is, since, by construction, is unable to capture any correlation between them.
15. In Appendix A2, we show the decomposition of the G-CSPI by the three I's of multidimensional poverty. However, it should be acknowledged that the use of a relative inequality measure, such as the Generalized Entropy for a bounded variable might not be consistent and might provide a misleading assessment of the extent of inequality; however, proving this empirically goes far beyond the scope of our paper.
16. More than 94% of the surveys were conducted since 2004 and nearly 65% since 2010. The full list of surveys used is given in Appendix A2. Appendix A2 indicates also which education variable was used to estimate the G-CSPI: in 71% of the cases was the (preferable) literacy variable.
17. We have estimates for India, but given that missing values represented more than 33.3% of the sample, we had to remove it.
18. To calculate the weights, the population of the relevant age group (15–65) was used.

## Disclosure Statement

No potential conflict of interest was reported by the author(s).

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## References

- Abdu, M., and E. Delamónica. 2018. "Multidimensional Child Poverty: From Complex Weighting to Simple Representation." *Social Indicators Research* 136: 881–905. doi:10.1007/s11205-017-1620-6.
- Alkire, S. 2007. "Choosing Dimensions: the Capability Approach and Multidimensional Poverty." In *The Many Dimensions of Poverty*, edited by N. Kakwani, and J. Silber, 89–119. New York: Palgrave MacMillan.
- Alkire, S. 2008. The Capability Approach to the Quality of Life." *OPHI Research in Progress 2a*, background paper for the Commission on the Measurement of Economic Performance and Social Progress.
- Alkire, S., and J. Foster. 2011a. "Understandings and Misunderstandings of Multidimensional Poverty Measurement." *The Journal of Economic Inequality* 9 (2): 289–314. doi:10.1007/s10888-011-9181-4.
- Alkire, S., and J. Foster. 2011b. "Counting and Multidimensional Poverty Measurement." *Journal of Public Economics* 95 (7–8): 476–487. doi:10.1016/j.jpubeco.2010.11.006.
- Alkire, S., and S. Jahan. 2018. *The New Global MPI 2018: Aligning with the Sustainable Development Goals. HDRO Occasional Paper*. UNDP.
- Alkire, S., and M. E. Santos. 2014. "Measuring Acute Poverty in the Developing World: Robustness and Scope of the Multidimensional Poverty Index." *World Development* 59: 251–274. doi:10.1016/j.worlddev.2014.01.026.
- Bennett, D. 2012. "Does Clean Water Make you Dirty?" Water Supply and Sanitation in the Philippines." *Journal of Human Resources* 47 (1): 146–173. doi:10.3368/jhr.47.1.146.
- Bérenger, V. 2017. "Using Ordinal Variables to Measure Multidimensional Poverty in Egypt and Jordan." *The Journal of Economic Inequality* 15 (2): 143–173. doi:10.1007/s10888-017-9349-7.
- Betti, G., B. Cheli, A. Lemmi, and V. Verma. 2008. "The Fuzzy set Approach to Multidimensional Poverty: The Case of Italy in the 1990s." In *Quantitative Approaches to Multidimensional Poverty Measurement*, edited by N. Kakwani, and J. Silber, 30–48. London: Palgrave-Macmillan.
- Biggeri, M., R. Libanora, S. Mariani, and L. Menchini. 2006. "Children Conceptualizing Their Capabilities: Results of a Survey Conducted During the First Children's World Congress on Child Labour." *Journal of Human Development* 7 (1): 59–83. doi:10.1080/14649880500501179.
- Burchi, F., and P. De Muro. 2016. "Measuring Human Development in High-Income Countries: A Conceptual Framework for Well-Being Indicators." *Forum for Social Economics* 45 (2-3): 120–138. doi:10.1080/07360932.2014.995196.
- Burchi, F., P. De Muro, and E. Kollar. 2014. "Which Dimensions Should Matter for Capabilities? A Constitutional Approach." *Ethics and Social Welfare* 8 (3): 233–247. doi:10.1080/17496535.2014.932415.

- Burchi, F., P. De Muro, and E. Kollar. 2018. "Constructing Well-Being and Poverty Dimensions on Political Grounds." *Social Indicators Research* 137 (2): 441–462. doi:10.1007/s11205-017-1618-0.
- Burchi, F., D. Malerba, N. Rippin, and C. E. Montenegro. 2019. Comparing Global trends in Multidimensional and Income Poverty and Assessing Horizontal Inequalities. DIE Discussion Paper 2/1019, Bonn.
- Burchi, F., N. Rippin, and C. E. Montenegro. 2020. "The Measurement of Multidimensional Poverty Across Countries: a Proposal for Selecting Dimensions." In *Dimensions of Poverty: Measurement, Epistemic Injustices, Activism (Chapter 14)*, edited by V. Beck, H. Hahn, and R. Lepenies, 281–300. Cham, Switzerland: Springer.
- Chiappero-Martinetti, E. 2006. "Capability Approach and Fuzzy Set Theory: Description, Aggregation and Inference Issues." In *Fuzzy Set Approach to Multidimensional Poverty Measurement*, edited by A. Lemmi, and G. Betti, 93–113. New York: Springer.
- Clark, D. A. 2005. "Sen's Capability Approach and the Many Spaces of Human Well-Being." *Journal of Development Studies* 41 (8): 1339–1368. doi:10.1080/00220380500186853.
- Datt, G. 2019. "Distribution-sensitive Multidimensional Poverty Measures." *The World Bank Economic Review* 33 (3): 551–572. doi:10.1093/wber/lhx017.
- Deaton, A. 1997. *The Analysis of Household Surveys. A Microeconometric Approach to Development Policy*. Baltimore, Maryland: Johns Hopkins University Press.
- Deaton, A. 2016. "Measuring and Understanding Behavior, Welfare, and Poverty." *American Economic Review* 106 (6): 1221–1243. <http://doi.org/10.1257/aer.106.6.1221>.
- Dotter, C., and S. Klasen. 2014. *The Multidimensional Poverty Index: Achievements, Conceptual and Empirical Issues*, UNDP, Occasional Paper.
- Duclos, J.-Y., and L. Tiberti. 2016. "Multidimensional Poverty Indices: A Critical Assessment." In *The Oxford Handbook of Well-Being and Public Policy*, edited by M. Adler, and M. Fleurbaey, 677–708. Oxford: Oxford University Press.
- Efron, B. 1981. "Nonparametric Standard Errors and Confidence Intervals." *The Canadian Journal of Statistics* 9 (2): 139–158. doi:10.2307/3314608.
- Espinoza-Delgado, J., and S. Klasen. 2018. "Gender and Multidimensional Poverty in Nicaragua: An Individual Based Approach." *World Development* 118: 466–491. doi:10.1016/j.worlddev.2018.06.016.
- Espinoza-Delgado, J., and J. Silber. 2018. "Multi-Dimensional Poverty among Adults in Central America and Gender Differences in the Three I's of Poverty: Applying Inequality Sensitive Poverty Measures with Ordinal Variables." *Discussion Papers* 237, Ibero-America Institute for Economic Research, University of Goettingen.
- Espinoza-Delgado, J., and J. Silber. 2021. "Using Rippin's Approach to Estimate Multi-Dimensional Poverty in Central America." In *Analysis of Socio-Economic Conditions: Insights from a Fuzzy Multidimensional Approach*, edited by G. Betti, and A. Lemmi, 32–52. United Kingdom: Routledge. doi:10.4324/9781003053712.
- Fink, G., I. Günther, and K. Hill. 2011. "The Effect of Water and Sanitation on Child Health: Evidence from the Demographic and Health Surveys 1986–2007." *International Journal of Epidemiology* 40 (5): 1196–1204. doi:10.1093/ije/dyr102.
- Fogden, J. 2009. *Access to Safe Drinking Water and its Impact on Global Economic Growth*. Bothell, WA: HaloSource. doi:10.12691/ajwr-5-3-2.
- Jenkins, S. P., and P. J. Lambert. 1997. "Three 'I's of Poverty Curves, with an Analysis of UK Poverty Trends." *Oxford Economic Papers* 49 (3): 317–327. doi:10.1093/oxfordjournals.oep.a028611.
- Klasen, S. 2015. SDGs: Better Process, Worse Outcome, *Opinion, RURAL 21*. [https://www.rural21.com/uploads/media/rural2015\\_01-S26-27.pdf](https://www.rural21.com/uploads/media/rural2015_01-S26-27.pdf).



- Koopmans, T. C. 1947. "Measurement Without Theory." *The Review of Economics and Statistics* 29 (3): 161–172.
- Lloyd-Sherlock, P. 2002. "Nussbaum, Capabilities and Older People." *Journal of International Development* 14 (8): 1163–1173. doi:10.1002/jid.958.
- Narayan, D., R. Patel, K. Schafft, A. Rademacher, and S. Koch-Schulte. 2000. *Voices of the Poor: Can Anyone Hear Us?* New York: Oxford University Press.
- Neff, D. 2013. "Fuzzy Set Theoretic Applications in Poverty Research." *Policy and Society* 32 (4): 319–331. doi:10.1016/j.polsoc.2013.10.004.
- Pogge, T., and S. Wisor. 2016. "Measuring Poverty: A Proposal." In *The Oxford Handbook of Well-Being and Public Policy*, edited by M. Adler, and M. Fleurbaey, 645–676. Oxford: Oxford University Press.
- Rippin, N. 2013. *Considerations of Efficiency and Distributive Justice in Multidimensional Poverty Measurement*. Doctoral Dissertation. George-August-Universität Göttingen, Germany.
- Rippin, N. 2017. "Efficiency and Distributive Justice in Multidimensional Poverty Issues." In *Measuring Multidimensional Poverty and Deprivation. Incidence and Determinants in Developing Countries*, edited by R. White, 31–67. doi:10.1007/978-3-319-58368-6.
- Robeyns, I. 2003. "Sen's Capability Approach and Gender Inequality: Selecting Relevant Capabilities." *Feminist Economics* 9 (2–3): 61–92.
- Robeyns, I. 2005. "The Capability Approach: A Theoretical Survey." *Journal of Human Development* 6 (1): 93–114. doi:10.1080/1354570022000078024.
- Sen, A. K. 1976. "Poverty: An Ordinal Approach to Measurement." *Econometrica* 44 (2): 219–231. <http://www.jstor.org/stable/1912718>.
- Sen, A. K. 1985. *Commodities and Capabilities*. Netherlands: North-Holland.
- Sen, A. K. 1992. *Inequality Reexamined*. Cambridge, MA: Harvard University Press.
- Sen, A. K. 2000. *Development as Freedom*. New York: First Anchor Books Edition.
- Sen, A. K. 2004. "Capabilities, Lists, and Public Reason: Continuing the Conversation." *Feminist Economics* 10 (3): 77–80. doi:10.1080/1354570042000315163.
- Silber, J., and G. Yalonetzky. 2014. "Measuring Multidimensional Deprivation with Dichotomized and Ordinal Variables." In *Poverty and Social Exclusion: New Methods of Analysis*, edited by G. Betti, and A. Lemmi, 9–37. Oxford: Routledge.
- Thorbecke, E. 2007. "Multidimensional Poverty: Conceptual and Measurement Issues." In *The Many Dimensions of Poverty*, edited by N. Kakwani, and J. Silber, 3–19. London: Palgrave-Macmillan.
- UNDG. 2013. *A Million Voices: The World We Want. A Sustainable Future with Dignity for all*. New York: United Nations Development Group (UNDG). <https://undg.org/wp-content/uploads/2016/12/The-World-we-Want.pdf>.
- UNDP. 2010. *Human Development Report 2010. The Real Wealth of Nations: Pathways to Human Development*. New York: UNDP.
- UNICEF & End Child Poverty Global Coalition. 2017. *A World Free from Child Poverty. A Guide to the Tasks to Achieve the Vision*. New York: UNICEF.
- Vijaya, R. M., R. Lahoti, and H. Swaminathan. 2014. "Moving from the Household to the Individual: Multidimensional Poverty Analysis." *World Development* 59: 70–81.
- Wisor, S., S. Bessel, F. Castillo, J. Crawford, K. Donaghue, J. Hunt, A. Jaggar, A. Liu, and T. Pogge. 2016. *The Individual Deprivation Measure: A Gender-Sensitive Approach to Poverty Measurement: Updated Version*. Melbourne: International Women's Development Agency.
- World Bank. 2018. *Poverty and Shared Prosperity 2018. Piecing Together the Poverty Puzzle*. Washington, DC: World Bank.
- World Bank. 2020. *Poverty and Shared Prosperity 2020. Reversals of Fortune*. Washington, DC: World Bank.